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Leaf Based Phenetic Analysis On The Selected Taxa From The Genus *Ficus* L (Moraceae) From Southern Western Ghats

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ABSTRACT

The present work is a leaf based phenetic study on the selected members of the genus *Ficus* from Southern Western Ghats. Sixteen morphological characters of the leaf considering 102-character states were studied. The species were collected and careful morphological observations were made. The morphological characters were standardised into numerical format with the presence or absence of each character state represented with 1 and 0 respectively. The data was analysed using PAST Ver 2 Software and a dendrogram was obtained. The species were alligned based on the similarities on leaf morphology. The dendrogram obtained showed that the leaf morphology-based clustering is not exactly similar to the current accepted sub generic classification of *Ficus.* But the clustering was almost similar to a habit-based classification of *Ficus* into plants with cauliflorous inflorescence, stranglers, epiphytic & hemi epiphytic trees and independent trees. Thus, it implies that the leaf morphology-based clustering in *Ficus* is similar to its habit pattern.

Key words: *Ficus*, Leaf morphology, Phenetic study.

INTRODUCTION

The genus *Ficus* L. (Moraceae) is one among the most abundant, complex and diverse angiosperms. The hypanthodium inflorescence, minute flowers and morphological complexity make the genera problematic. They are commonly called as 'Fig' plants. About 750 species of *Ficus* is distributed in the world, chiefly in the tropics and sub tropics (Corner, 1965; Berg & Corner, 2005). India has a diversity of 115 taxa of *Ficus,* majority of them distributed in the North Eastern regions (Chaudhary *et al*., 2012). Around 40 species of *Ficus* have been reported from the Western Ghats region. According to the current classification, the genus is divided into six subgenera based on overall morphological and sexual features (Berg, 2003).

Leaf architecture was greatly used in systematic studies to delimit the genera and species in families like Rosaceae, Araceae, Lauraceae etc. (Merriell, 1978; Klucking, 1987; Hyland, 1989; Ray, 1992). Leaf architecture studies were done on the genus *Ficus* (Kumar & Jain, 1986; Loutfy, 2005). Phenetic analysis on the leaves of 12 *Ficus* species was done in the present study to understand the clustering pattern. Also, to check whether the leaf morphology-based clustering is similar to the current subgeneric system of classification.

METHODOLOGY

12 species of *Ficus* each belonging to different subgenera, present in the Southern Western Ghats region were selected for the study. The selected species and the respective subgenus (Berg, 2003; Berg and Corner, 2005) are provided in table 1.

Sl. No	**Species**	**Subgenus**
1	*Ficus callosa* Wild.	Pharmacosycea
2	*Ficus nervosa* Heyne ex Roth	Pharmacosycea
3	*Ficus tinctoria.* ssp. *parasitica* (J. Koenig ex wild.) Corner.	Sycidium
4	*Ficus auriculata* Lour.	Sycomorus
5	*Ficus binnendijkii* (Miq.) Miq.	Sycomorus
6	*Ficus racemosa* L.	Sycomorus
7	*Ficus amplocarpa* Govind. & Masil.	Synoecia
8	*Ficus guttata* (Wight) Kurzex Hook.	Synoecia
9	*Ficus pumila* L.	Synoecia
10	*Ficus benjamina* L.	Urostigma
11	*Ficus microcarpa* L.f.	Urostigma
12	*Ficus talbotii* King.	Urostigma

Table 1. Selected species of *Ficus* and their sub genus.

The morphological characters of the leaves were observed and documented (Fig 1). Sixteen characters and 102-character states were considered for the study (Table 2).

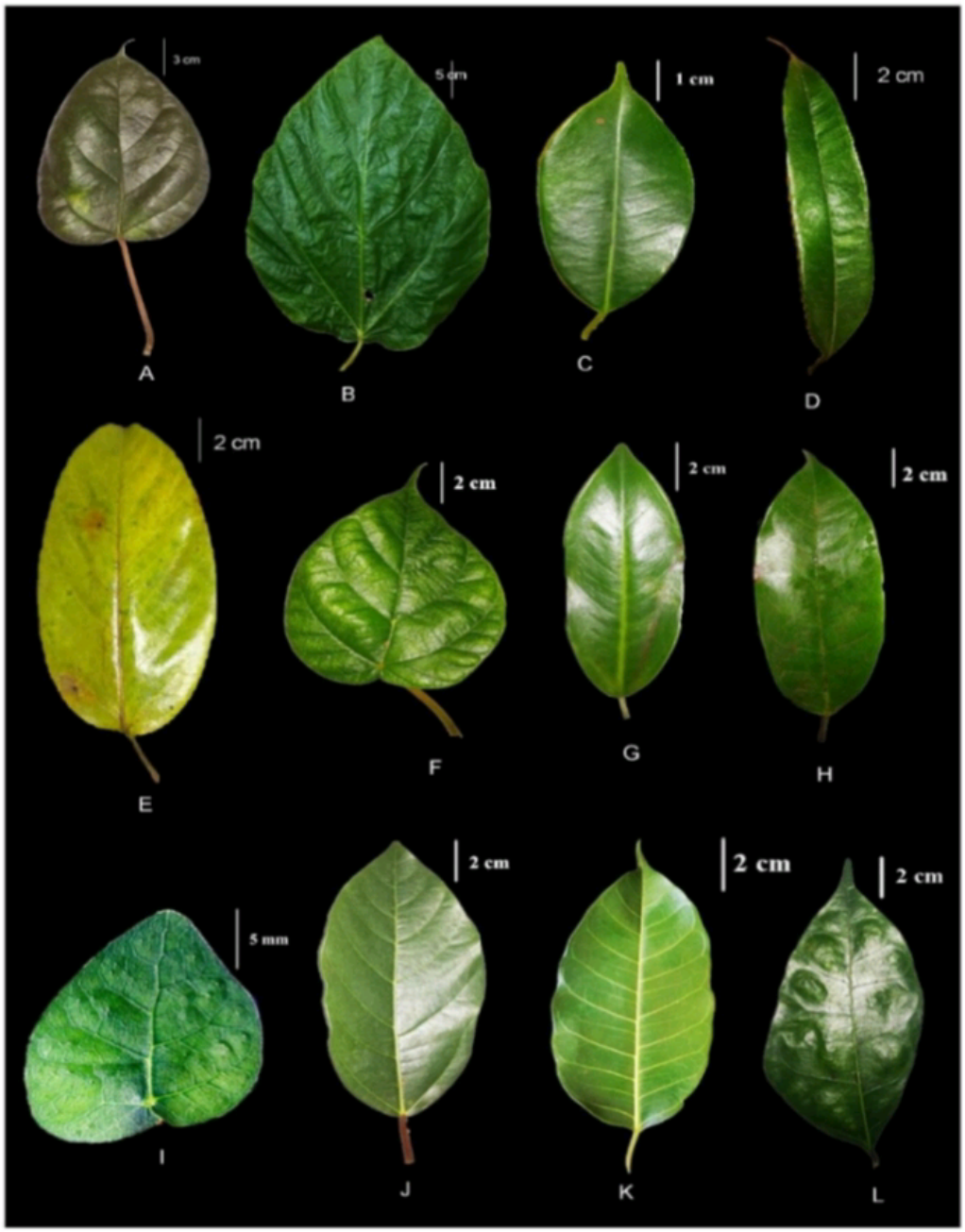

Fig 1. Leaves of the *Ficus* species studied. **A.** *Ficus amplocarpa*; **B.** *Ficus auriculata*; **C.** *Ficus benjamina*; **D.** *Ficus binnendijkii*; **E.** *Ficus callosa*; **F.** *Ficus guttata*; **G.** *Ficus microcarpa*; **H**. *Ficus nervosa*; **I.** *Ficus pumila*; **J**. *Ficus racemosa*; **K.** *Ficus talbotii*; **L.** *Ficus tinctoria*. ssp. *parasitica.*

Sl. No	Character studied	Character state
1	Arrangement	Alternate, Opposite
2	Shape	Ovate, Broadly ovate, Lanceolate, Round, Elliptic, Lance ovate, Oblong, Obovate
3	Length Max	0 - 5.0 cm, 5.1 - 10.0 cm, 10.1 -15.0 cm, 15.1 -20.0 cm, 20.1 -25.0 cm, 25.1 - 30.0 cm, 30.1 - 35.0 cm, 35.1- 40.0 cm, Above 40.1 cm
4	Length Min	0 - 5.0 cm, 5.1 - 10.0 cm, 10.1 -15.0 cm, 15.1 -20.0 cm, 20.1 -25.0 cm, 25.1 - 30.0 cm, 30.1 - 35.0 cm, 35.1- 40.0 cm
5	Width Max	0 - 5.0 cm, 5.1 - 10.0 cm, 10.1 -15.0 cm, 15.1 -20.0 cm, 20.1 -25.0 cm, 25.1 - 30.0 cm, 30.1 - 35.0 cm, 35.1- 40.0 cm
6	Width Min	0 - 5.0 cm, 5.1 - 10.0 cm, 10.1 -15.0 cm, 15.1 -20.0 cm, 20.1 -25.0 cm, 25.1 - 30.0 cm, 30.1 - 35.0 cm, 35.1- 40.0 cm
7	Nature	Coriaceous, Sub coriaceous, Leathery, Chartaceous
8	Margins	Entire, Undulate, Serrate, Lobed
9	Apex	Acute, Acuminate, Cuspidate, Obtuse, Rounded, Caudate
10	Base	Obtuse, Rounded, Cordate, Cuneate, Sub cordate
11	Indumentum	Glabrous, Pubescent, Puberulous, Tomentose, Scabrous, Strigose
12	Min Veins	1 or 2, 3 or 4, 5 or 6, 7 or 8, 9 or 10, 11 or 12, 13 or 14
13	Max Veins	1 or 2, 3 or 4, 5 or 6, 7 or 8, 9 or 10, 11 or 12, 13 or 14, Above 14, Numerous
14	Length Min	0 - 2.0 cm, 2.1 - 4.0 cm, 4.1 - 6.0 cm, 6.1 - 8.0 cm, 8.1 - 10.0 cm
15	Length Max	0 - 2.0 cm, 2.1 - 4.0 cm, 4.1 - 6.0 cm, 6.1 - 8.0 cm, 8.1 - 10.0 cm, 10.1 - 12.0 cm, 12.1 -14.0 cm, Above 14.1 cm
16	Indumentum	Glabrous, Pubescent, Tomentose, Puberulent, Scabrous

Table 2. Character and character states studied

The morphological characters were converted and standardised into numerical format. The presence and absence of each character state was represented with 1 and 0 respectively. Equal weightage was given for all the character states studied (Sneath & Sokal, 1973). The numerical data was analysed using PAST Ver 2 software and a dendrogram based on morphological similarity was obtained. The clustering was compared with the currently

accepted system of subgeneric classification, to check whether the leaf morphological clustering is similar to the subgeneric classification or not.

RESULT

The 12 species of *Ficus* studied showed morphological variations in leaf characters. They showed variations in the size, shape and indumentum pattern of the leaf. The phenetic analysis separated the 12 species of *Ficus* with considerable level of dissimilarity based on the leaf morphology (Fig 2).

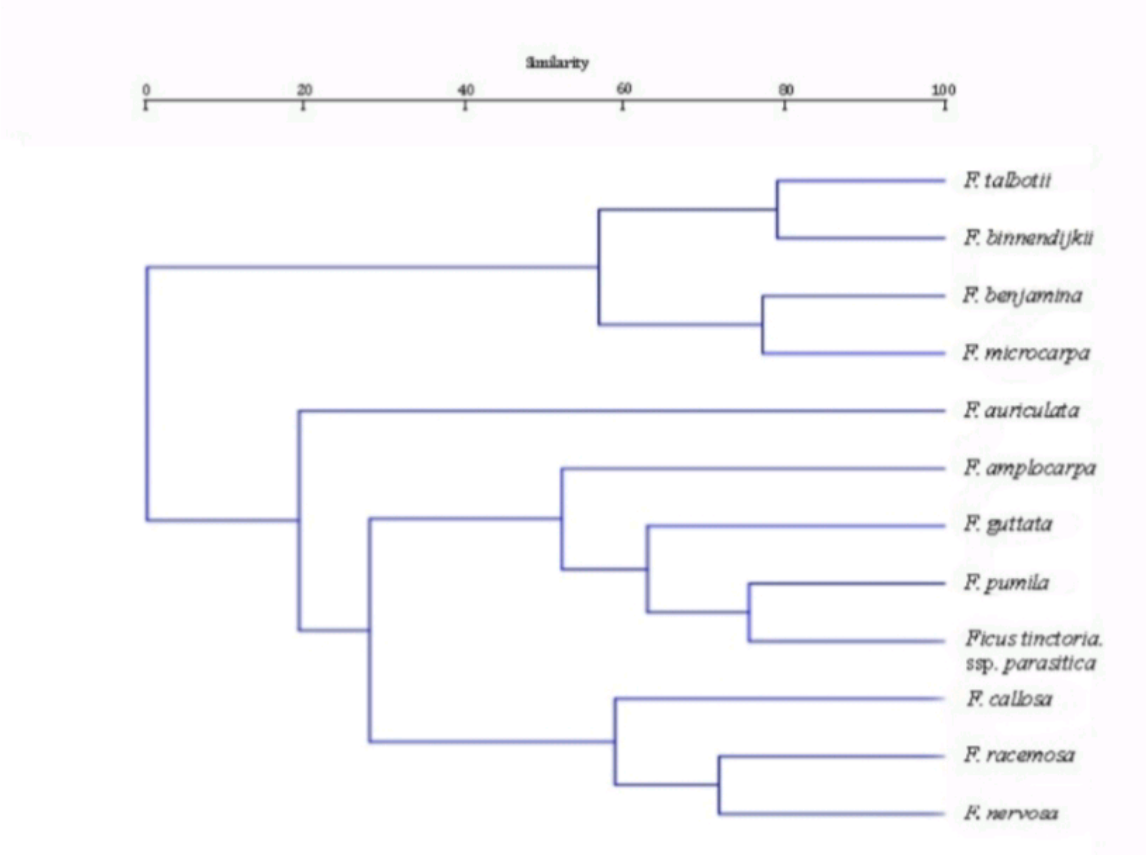

Fig 2. Dendrogram generated using PAST Ver 2 software showing leaf morphology-based clustering.

The maximum similarity was observed for *F. talbotii* & *F. binnendijkii*, with a similarity value of 80 %. On comparison with the current classification of *Ficus* (Berg, 2003), the leaf morphology-based clustering was entirely different. Most of the subgenera was not clustered together. The much similar clustering was observed for the subg. *Urostigma* with all the three species clustered together along with a subg. *Sycomorus* member. Thus, it was observed that the leaf morphology-based clustering is different with the current system of classification.

DISCUSSION

The current accepted classification of *Ficus* is based on both morphological and sexual features (Berg, 2003). But molecular data do not support such a classification (Ronsted *et al,* 2008). There exists a habit-based classification in the genus, with few mentions in the literature. Rheede (1678) in his book 'Hortus Malabaricus' has cited the members in the genus *Ficus* as 'Atthi' (Plants with cauliflorous inflorescence), 'Itthi' (stranglers hemi-epiphytic and epiphytic trees) and 'Aal' (independent trees). Matthew (1995) also considered such a grouping in the genus. These terms 'Atthi', 'Itthi' and 'Aal' are the local or vernacular names denoted to the members of this genus in South India. The leaf morphology-based clustering also follows such a grouping similar to the habit-based grouping (Fig 3).

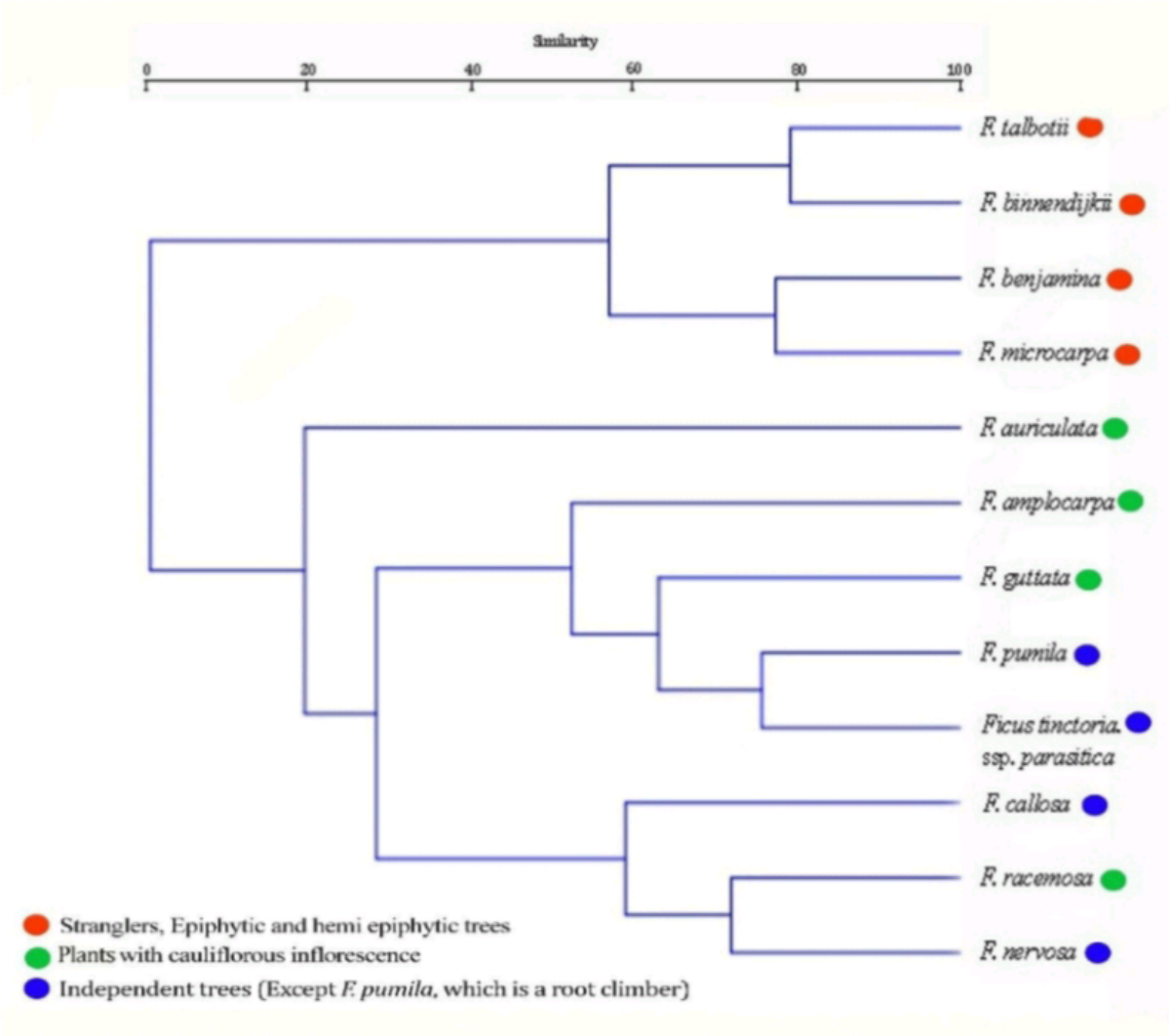

Fig 3. Dendrogram showing habit-based clustering.

All the stranglers and epiphytes were clustered together as a single group. The independent trees and plants with cauliflorous inflorescence were clustered as another group.

F. racemosa, a tree with cauliflorous inflorescence was clustered together with independent trees. *F. racemosa* is an independent tree that shows axillary inflorescence along with cauliflorous inflorescence. All the members of the subg. *Synoecia* are root climbers. They are not epiphytic trees. Here, *F. pumila* is considered as an independent tree, as the species is not an epiphyte and is having axillary inflorescence, not cauliflorous. Thus, with only minor deviations, the leaf-based clustering is much more similar to the habit-based classification than the current morphology and sexual features-based classification.

CONCLUSION

The leaf-based clustering is showing less similarity with the current classification of *Ficus.* It is much similar to the habit-based classification. Hence, it could be concluded that a detailed study including more morphological characters and a greater number of species could give more idea on the habit based-classification. And can confirm whether the habit-based clustering fits better than the morphology and sexual features-based classification.

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REFERENCE

Berg, C. C. (2003). Flora Malesiana precursor for the treatment of Moraceae 1: the main subdivision of Ficus: the subgenera. Blumea-Biodiversity, Evolution and Biogeography of Plants, 48(1): 166-177.

Berg, C. C. & Corner, E. J. H. (2005). Moraceae - *Ficus*. Flora Malesiana Series I (Seed Plants). 17: 1–730.

Chaudhary, L. B., Sudhakar, J. V., Kumar, A., Bajpai, O. & Tiwari, R. (2012). Synopsis of the Genus Ficus L. (Moraceae) in India. Taiwania 57(2): 193–216.

Corner, E. J. H. (1965). Check List of Ficus in Asia and Australasia with keys to identification. Gardens Bulletin, Singapore 21: 1–186.

Hyland, B. P. M. (1989). A Revision of Lauraceae in Australia (excluding Cassytha). Australian J. Syst. Bot., 2: 135–67

Klucking, E. P. (1987). Leaf Venation Patterns Vol. 2, Lauraceae. Gebruder Borntraeger Verlagsbuchhandlung.

Kumar, P. and D. K. Jain. (1986). Leaf architecture in some Indian species of Ficus. Acta Bot. Indica, 14: 93–100

Loutfy, M. H. A., Karakish, E. A. K., Khalifa, S. F., & Mira, E. R. A. (2005). Numerical taxonomic evaluation of leaf architecture of some species of genus Ficus L. Int. J. Agric. Biol, 7, 352-357.

Matthew, K. M. (1995). An excursion flora of central Tamil Nadu, India. CRC Press.

Merriell, E. K. (1978). Comparison of mature leaf architecture of three types in Sorbus L. (Rosaceae). Bot. Gaz., 139: 447–53

Ray, T. S. (1992). Landmark eigenshape analysis: homologous cotours: leaf shape in Syngonium (Araceae). Am. J. Bot., 79: 69–76

Rheede Tot Draakestein, H. A. Van. (1678). Hortus indicus malabaricus. Vol. 1. Amsterdam: J. van Someren & J. van Dyck. http://dx.doi.org/10.5962/bhl.title.707

Ronsted, N., Weiblen, G. D., Clement, W. L., Zerega, N. J., & Savolainen, V. (2008). Reconstructing the phylogeny of figs (Ficus, Moraceae) to reveal the history of the fig pollination mutualism. Symbiosis (Rehovot), 45(1), 45.

Sneath, P. H. A. & Sokal, R. R. (1973). Numerical taxonomy. Freeman and Company, San Francisco, USA.